the engineering plans and operations adopted for the storage and conduction of the Plenty water, as the high professional standing of the engineer to the commission, and the administrative ability of the president, should be a sufficient guarantee that the details of the scheme will be efficiently carried out. I cannot but regret that I have been compelled to express my dissent from the views entertained by several gentlemen whose judgment and ability I deeply respect, and to whom I beg to apologise for the introduction of their names into this paper.

ART. XV.—*Report of the Commissioners appointed by the Philosophical Society of Victoria, to investigate the alleged insufficiency of supply for the Yan Yean Water Works by Dr. Wilkie.*

TO THE PRESIDENT AND MEMBERS OF THE PHILOSOPHICAL SOCIETY OF VICTORIA.

MR. PRESIDENT AND GENTLEMEN,—In compliance with your resolution of the 9th on January last, requesting us to report on the alleged insufficiency of supply available for the Yan Yean Water Works, as conveyed in a paper read before your Society by Dr. Wilkie on the same day, we have the honour of laying before you the following report.

Our first step in the prosecution of this inquiry, was, to proceed to the Yan Yean reservoir, and to examine its modes of supply, as also the drainage-basin of that part of the River Plenty that is intended to feed it, where we made measurements of discharge, in order to guide our conclusions.

Our subsequent investigations were directed to ascertaining the different sources of supply and loss, and therefrom obtaining the available amount.

Foremost among the causes of loss stand evaporation, in soils and still water, the former of which, from the various conflicting conditions under which it occurs in this instance, cannot be easily ascertained from scientific deductions, but is rather a practical question, to be dealt with by the results it exhibits; the latter we obtained from the careful experiments and deductions of Dr. Davy, to whom we are much indebted for communicating the results of his valuable experiments.

Our aim in arriving at and adopting our conclusions, have been rather to exaggerate our amounts of loss, while we have only accepted so much of our supply as was warranted by data, although apparently larger, so that our results might represent the minimum, if not the actual amount.

Impressed as we are with the difficulty and intricacy of this question, in a locality where so many conditions come into play, and, consequently not subject to deductions from known data, we approach this subject with great diffidence, and hope that the mode in which we treat it, to the best of our humble abilities, shall receive from your society a candid and considerate judgment.

We commenced our investigations on the 24th of January, by measuring the discharge of the River Plenty, one mile below the reservoir, at the bridge, being the same place alluded to in Dr. Wilkie's paper, as measured by him, and giving 153·8 cubic feet per minute, and on which he based the supply by the Plenty, at 3,000,000 cubic yards per annum; our measurement of discharge at this place was only 75·9 cubic feet per minute, deduced from a sectional area of thirty-eight square feet, and surface velocity of ·05 feet per second, or only half that of Dr. Wilkie's discharge. We then followed up the river to the reservoir, at which point we found it diverted into the puddle trench of the new embankment, and dammed up for the use of a water-wheel, which at once accounted for the smallness of discharge at the bridge, as also Dr. Wilkie's previous discharge. Proceeding further up, we came to that point of the river where it joins with the aqueduct, or inlet, for supplying the reservoir, here, finding a clear and uniform flow, we took two accurate sections, the mean of which, or, 13·2 square feet we adopted, also the surface velocity, from a number of experiments equal to 8·568 inches per second, the mean velocity being obtained by the following formula, double the square root of surface velocity, in inches, deducted from surface velocity, and one added, gives the velocity at bottom, the mean velocity is half the sum of top and bottom velocities, was found to be 6·15 inches per second, hence the discharge was 406 cubic feet per minute, or more than two and half times that of Dr. Wilkie's discharge at the bridge.

Further up we crossed the river at Mr. Sherwin's Bridge, at which point it flows out of the swamps, and a little above which it divides into two arms, one from the westward, the other from the eastward. We followed up the western arm two miles, the whole of which distance it was nothing more than a swamp, about 100 yards wide, having no defined channel, and over the surface of which, the whole flow of the water is diffused, and exposed to evaporation nearly equal to still water, This swamp was composed of vegetable matter to an unknown depth, and so boggy, that a fencing rail was forced into it by one man to a depth of five feet; the flow of water at this point was so trifling that it could not be measured, and was probably all evaporated before reaching the junction with the eastern arm. From minute inquiries we learnt that this swamp extended two and half miles further up, making in all four and half miles of swamp, averaging 100 yards wide, thus exposing 787,000 square yards to surface evaporation. We did not follow this arm up to its source, but we feel satisfied that it affords little, if any, supply to the Plenty during the summer months, and on this occasion none.

We then proceeded to examine the eastern arm, which also flows, with the exception of a slight divergence, through a swamp, for two and a half miles above its junction with the western arm. This swamp is two and a half miles long, and averages 700 yards wide, having, therefore, a superficial extent of 3,000,000 square yards; it is charged with water from the eastern arm, and is in some places less boggy than the western arm, and the flow of water through it has a more defined channel and consequently has a less proportionate evaporation. We measured this discharge about two miles up, and found it to be 712 cubic feet per minute, the surface velocity being 10·18 inches per second, and sectional area 14 square feet, the mean velocity being obtained, same as in former case; it is thus $1\frac{3}{4}$ times the discharge of the Plenty, where previously measured at aqueduct below the swamp; thus showing, that at that time 43 per cent of the discharge was lost by evaporation in the swamp.

Our next subject of inquiry was relative to the source from which the River Plenty derived its supply in the summer months, as it was perfectly evident that there was no surface drainage into it from its basin, excepting after heavy rains, the surface of the ground being quite dry, and the eastern arm the while discharging a strong current of water; to this end we determined to follow up the eastern arm to its source. Proceeding accordingly, we crossed Jack's Creek, which is a fine tributary to the eastern arm, and through which a considerable volume of pure water was flowing; and pursuing the eastern or main arm, we crossed the Sugar Loaf Creek, which is another small tributary of good water being now at the foot of the Ranges, we again crossed the eastern arm at the Ford, and commenced ascending up a deep gully or gorge down which it flows. This gully is clothed with verdant and dense vegetation, consisting of tree-ferns, &c., increasing in luxuriance and beauty according as we ascended, having climbed for two miles over dislocated granite rocks and fallen trees, and through dense scrub, we came in upon the river, where it formed a magnificent cascade, the water falling over immense granite rocks for a height of fifty feet, the sides of the stream being formed of granite blocks, in the interstices of which the tree-ferns grew in the greatest luxuriance, forming a scene of great beauty. In this lovely spot we rested under the shade of the tree-ferns, and having tasted the water were surprised at its extreme coldness. We continued our ascent up the stream, sometimes forcing our way through dense scrub and climbing from rock to rock; the stream gradually decreasing in volume, being fed from its sides by small supplies of water, which we observed frequently ousing out from a dense spongy mass composed of tree-fern roots and other vegetable matter, on the surface and in the interstices of the granite. We at length arrived at the summit, which is near that of Mount Disappointment, where there was still a very slight stream flowing in a small gully, on apparently table land, where it turned to the left.

Having thus traced up the eastern arm of the River Plenty to its principal source, we beg to offer the following opinion as to the mode by which that source is fed:—

The eastern arm of the River Plenty, taking its rise near the summit of Mount Disappointment, flows over a granite bed down a deep gully, the sides of which are composed of immense granite blocks, the surfaces of which are covered and the interstices filled with a mass of spongy vegetable matter, capable of retaining a large quantity of water, and giving it out slowly. The natural fissures of the granite serve the same purpose of storing the water, which was proved by its intense coldness on a very hot day.

This description appears to be the general character of the Ranges, and coincides with Mr. Hodgkinson's report on the source of the western arm.

We therefore, conclude, that as these interstices and fissures store an immense body of water obtained from rainfalls, and a moisture from clouds that are attracted over, and lie upon Mount Disappointment, they hence constitute the original and only constant source of supply to the River Plenty.

The summer supply of the Plenty is derived wholly from these sources, excepting after heavy rains, as it was evident that it received no surface drainage whatever, when we measured its discharge, but was solely supplied by its eastern arm which led from one of the sources. The discharge of the River Plenty, therefore, as measured by us, is only an index of the supply derivable from one of the sources, which has but a limited drainage area, and does not represent the quantity due from the surface drainage of its basin. Hence any calculations founded on this discharge as the only available amount passing through the Plenty, and for supplying the reservoir, must be erroneous, inasmuch as it is only storage water from the ranges, and not due to recent rainfalls. We are further of opinion, that in consequence of the steep character of the basin in question, facilitating a rapid delivery of its rainfalls into the Plenty, and the Plenty discharge being always dependent upon the amount and duration of the rainfalls, and hence constantly varying, that no single measurement of discharge, at any given time, can be depended upon for a useful result.

Impressed with these views, we consider our actual measurement of discharge taken above and below the swamps, as only valuable in furnishing us by their difference, with the amount of loss from absorption and evaporation in the swamps.

With a view therefore to estimate the total amount available from the River Plenty, for the supply of the reservoir, we propose to take the rainfall on the basin supplying that part of the Plenty, as a basis, and from it make deduction for surface absorption, and evaporation loss, by swamps, &c.

The River Plenty, above the reservoir, drains a basin comprising at least sixty square miles of superficial extent, including the southern half of Mount Disappointment and contiguous ranges, it rests, with the exception of the ranges, on the slate formation, and has a close impervious surface, incapable of more than surface absorption, and the whole presents, with the exception of a few square miles, a steep basin-like form, favorable to a rapid delivery of its rainfalls into the Plenty, which is materially assisted by the non-absorbent character of the surface.

The mean rainfall upon this basin will therefore represent the total supply of water thereto, the mean annual rainfall for Melbourne, according to Archer's Statistical Table, is 30·85 inches, or thirty-one inches nearly; in the absence of experiments on the rainfall in this locality, we are compelled to accept this amount as the general rainfall, but it was perfectly evident, that over Mount Disappointment, and the surrounding ranges, there was a much greater amount of moisture derived, either from rainfall or atmospheric humidity, or both, due to its superior elevation; this was abundantly proved by the altered character of the vegetation in the ranges, consisting of immense gum trees, 250 feet high, tree-ferns, thick scrub, and other plants, whose growth and luxuriance indicated a great amount of moisture, as also a thick vegetable soil, capable of holding a large quantity of water; but, as this increased vegetation appears to be the effect of the increased moisture, and hence, consumes as nutriment a large proportion of it, if not all, we are hence not prepared to assert that any portion of this additional moisture over Mount Disappointment swells the supply already estimated at thirty-one inches over the whole basin, which depth of rainfall we therefore adopt.

Having, therefore, taken the rainfall, we have next to estimate what proportion of it will be delivered into the Plenty, or that amount which is left and flows over, after surface absorption and evaporation.

This amount will materially depend upon the declivity of the surface, combined with the imperviousness of the soil, and the number and duration of the rainfalls. In the absence of data on this subject, in this country, we are obliged to fall back upon English data, although obtained under different conditions. In England, according to G. D. Dempsey's work on *Drainage of Districts and Lands,* in Wheale's Series, the mean annual amount evaporated from the surface of the ground, is 57·6 per cent. of the rainfall, leaving 42·4 per cent. as available for collection; assuming therefore that 58·6 is the correct per centage of evaporation for England, we propose to take such a comparative view of its conditions in England, relatively with those in the Plenty basin, as shall enable us to form a practical judgment as to the applicability of this per centage of evaporation to the Plenty basin.

This English per centage of loss of 57·6, is in a country highly favorable to evaporation, owing to its cultivated surface exposing a loose spongy soil, capable of holding a large amount of rainwater while being evaporated by the sun, also to the slightly undulating character of the country, not involving so rapid delivery of its rainfalls into the rivers, and finally from the differences of the rainfalls producing milder showers, a a greater proportion of which must necessarily be evaporated from longer exposure.

On the other hand, the basin in question is composed mostly of steep ranges and hills, presenting only a few square miles of flat land, and hence capable of delivering its surplus waters with rapidity into the Plenty; it also has, for the most part, a close impervious surface, undisturbed by agriculture, and only capable of surface absorption, which character of soil, combined with slope, is unfavourable to loss from evaporation on its surface. The rainfalls also being mucn less frequent, and consequently heavier than in England, it is evident that under similar circumstances there would be less loss from evaporation, than if more diffused, as in England.

It is reasonable therefore to conclude, that if 57·6 per cent. of rainfall is lost by surface evaporation in England, under circumstances highly favorable to evaporation, a much smaller per centage of the rainfall will be lost when the same circumstances are very unfavorable, as in the basin in question. We should hence be justified in estimating a much less per centage of loss from evaporation in the basin of the Plenty, were it not that another important question must enter into the calculation, namely the difference of temperature, equal to ten degrees in favour of evaporation in the Plenty basin, which must act to some extent as a counterpoise against its unfavourable character, for same in other respects notwithstanding that the action on evaporation does not last nearly as long as the English temperature.

Viewing therefore the conditions of the surface drainage of England relatively with those of the basin of the Plenty, we are of opinion that the English per centage of evaporation of 57·6, if correct, embraces that of the Plenty basin, if it does not exceed it. We hence proceed in our calculations on this assumption, leaving it further on to be shown how it is borne out by the facts.

This per centage of 57·6 will therefore give 17·856 inches on 31 inches rainfall, the supply from rainfall of 31 inches and loss on same by evaporation will therefore stand thus,

Rainfall of 31 inches on basin of 60 square miles, superficial extent, or 185,856,000 square yards	160,042,666 cub. yards.
Loss due to surface absorption and evaporation over same extent, to depth of 17·856 inches	92,184,564 cub. yards.
Balance delivered into the Plenty ...	67,858,102 cub. yards.

Having thus ascertained the amount discharged into the Plenty, on this assumption, it is next necessary to determine the amount of loss entailed, by the passage of its western and eastern arms through the swamps.

The swamp on the western arm as before stated, has a superficial extent of 787·000 square yards, over which its waters are spread, thus exposing them to evaporation almost as in still water, to obtain the loss from which, the annual depth evaporated should be multiplied into the superficial extent. We have been kindly favoured by Dr. Davey with the results of his experiments on evaporation in still water, for the three summer months, which give ·55 inch per day, equal to 42·5 inches for the three months. He has further furnished us with a proportionate evaporation for the rest of the year, as follows:—

Evaporation for the six autumnal months, equal to four-thirds of the three summer months	66·0 inches
Evaporation for the three winter months, equal to one-sixth of the three summer months, equal	8·2 inches
And adding evaporation for the three summer months	49·5 inches
We have	123·7 inches

or 10·3 feet equal depth of water evaporated annually.

As this amount was partly derived from inference and therefore not absolutely proved, however certain; we requested Dr. Davey to furnish us with such an amount as in his opinion did not admit of a doubt, and were accordingly informed that we might safely adopt nine feet.

Hence the amount evaporated in the western swamp can be obtained by multiplying the superficial extent, equal to 787,000 square yards by the depth of evaporation, or nine feet, but as 17·856 inches has already been allowed for surface evaporation over the whole basin, this amount must be deducted from the nine feet, thus leaving 7·512 to be multiplied into the area of the swamp, thus giving 1,970,648 cubic yards evaporated per annum on the western swamp.

The loss by evaporation in the swamp on the eastern arm, must be determined in a different manner, inasmuch as the water is not spread over its surface, but rather absorbed by it. This loss is accurately represented by the difference between the measured discharge above and below the swamp on the same day; the discharge of the eastern arm, near the head of the swamp, was on January 24th, 37,990 cubic yards per day, the sectional area being fourteen square feet, and mean velocity 10.18 inches per second; the discharge below the swamp, at junction of the Plenty with aqueduct, was 21,653 cubic yards per day, the sectional area being 13·2 square feet, and mean velocity 6·15 inches per second; the discharge above the swamp therefore exceeds that below the same, by 16,337 cubic yards per day, this amount therefore fairly represents the rate of loss from evaporation for the three summer months; this spread over the area of the swamp, or 3,000,000 square yards, gives a depth of evaporation of ·1958 inches per day, or 17·82 inches for three summer months. Then by Dr. Davey's rule four-thirds of this, or 23·76 inches, will equal evaporation for six autumnal months, and one-sixth, or 2·97 inches will be evaporation for three winter months, the sum of all these give 44·55 inches for the year, but we have already allowed 17·856 inches for surface evaporation all over the basin, which must therefore be deducted, leaving 26·69 inches depth of evaporation for the year in the eastern swamp equal to 2,224,157 cubic yards.

The total amount of loss by evaporation due to the western and eastern swamps is therefore 4,194,805 cubic yards, and this deducted from the amount received into the Plenty already ascertained, or 67,858,102 cubic yards, leaves 63,663,297 cubic yards, equal to the whole amount available for collection from the River Plenty.

Having now arrived at the total effective discharge of the Plenty, above the reservoir, and as this result has been obtained on the assumption that 57·6 per cent of the rainfall, or 17·854 inches truly represents the amount of loss from surface evaporation, we now propose to test the correctness of that assumption through the medium of the results obtained therefrom. If therefore the effective discharge of the Plenty per annum, or 63,663,297 cubic yards, obtained on this assumption of the correctness of 57·6 as the per centage of evaporation, be confirmed by legitimate calculations and deductions, it may hence be inferred that the assumption of evaporation itself, or 57·6 is correct.

The eastern arm of the Plenty discharges in summer, as before stated, 11·87 cubic feet per second, which we were informed was its ordinary least discharge; the sectional area of this discharge is fourteen square feet, and mean velocity 10·18 inches per second as before obtained; having both which, we obtain the fall in two miles by Eytewein's formula, as follows:—The velocity in a second is ten-elevenths of a mean proportional between the hydraulic mean depth and the fall in two miles, hence the fall in two miles will be 8·1 inches; now the section of the eastern area at this point is rectangular, and the ordinary winter level, irrespective of floods, as pointed out by a resident on the spot, on particular inquiry, is exactly three feet above the summer level at this point, hence we obtain the sectional area of the winter discharge, equal to forty-one square feet, and having already the fall in two miles equal to 8·1 inches, we can obtain by Eytewein's formula as above quoted, the velocity equal to 1·15 feet per second, which multiplied by the sectional area, forty-one square feet, gives 47·15 cubic feet per second as the winter discharge.

Hence having the summer and winter discharges per second, we obtain the mean discharge by taking the half of their sum, which is 29·51 cubic feet per second, or 34,467,680 cubic yards per annum, and then deducting the loss from the eastern swamp already obtained, equal to 2,224,157 cubic yards, we have 32,243,523 cubic yards as the effective mean discharge of the eastern arm per annum.

As the western arm has a larger drainage area than the eastern arm, and the loss in its swamp not so much, and as all its conditions relative to imperviousness, slope, rainfall, &c., are precisely similar, it is evident that it must have at least as great a mean discharge, if not greater; hence the combined mean discharge of both arms will be at least double that of the eastern, or 64,487,046 cubic yards, equal to the effective mean discharge of the Plenty above the reservoir, according to this calculation.

But the result previously arrived at by the application of the English per centage of evaporation of 57·6 of the rainfall, was 63,663,297 cubic yards, thus leaving only 823,749 cubic yards difference between the two calculations.

As the calculation of effective discharge for the Plenty, previously made upon the assumed correctness of 57·6 per centage of loss from evaporation is so amply confirmed by this last calculation, we adopt it as correct.

The whole effective discharge of the Plenty above reservoir, or 63,663,297 cubic yards, is therefore the amount available for collection.

But as it cannot be supposed that the whole waters of the Plenty can be diverted into the reservoir, and thus be abstracted from the settlers along its banks, we assume that at least half of its whole amount will be retained for their use, leaving the other half, or 31,831,648 cubic yards, for the supply of the reservoir.

As therefore this amount has to be conveyed by the aqueduct before mentioned, leading from the Plenty to the reservoir, it is necessary to ascertain the aqueduct's capacity of discharge, especially as some of this supply will come in the form of floods, and also the amount likely to be carried down by the Plenty during the greatest ordinary floods.

One inch rainfall in twenty-four hours is seldom exceeded, and may therefore represent the greatest ordinary flood that may be expected, and as such a rainfall may fall within twenty-four hours, or in half that period, it may be delivered into the Plenty within twenty-four hours from its commencement, owing to the steep character of its basin, the loss it is liable to sustain in its passage over the ground into the Plenty will be considerably diminished if the ground was previously saturated, as may be the case, while the loss in the swamp will be increased owing to the spreading out of the water.

Taking these circumstances into consideration, we conclude that three-fourths of the inch of rainfall may possibly reach the Plenty and be delivered in twenty-four hours at its junction with the aqueduct.

This amount is equal to 3,871,999 cubic yards in twenty-four hours, but as half of this amount must remain in the Plenty, the aqueduct will only be required to convey the other half, or 1,935,999 cubic yards in twenty-four houss.

We have measured the sectional area of the aqueduct which runs along sideling ground, so that for the most part it only requires a bank on its lower side, that on the upper side being formed by the natural slope of the hill along which it runs.

It contained 127 square feet of sectional area, and assuming it had a fall of twelve inches per mile, the mean velocity per second will be, by Eytewein's formula, ten-elevenths of a mean proportional, between the hydraulic mean depth and the fall in two miles, the hydraulic mean depth being found by dividing the sectional area, 127 square feet, by the wet contour thirty-four feet, equal to 3·73 feet or 44·76 inches, hence the square root of the product of the hydraulic mean depth 44·76 with the fall in two miles, 24 inches, will be the mean proportional, or 32·8 inches, ten-elevenths of which will be the mean velocity, or 29·8 inches per second, this velocity multiplied with the sectional area, 127 square feet, will give the discharge per second equal to 315 cubic feet, or 1,008,000 cubic yards in twenty-four hours. The aqueduct therefore with this sectional area of 127 square feet and assumed fall of 12 inches, (more than which it cannot judiciously have) is insufficient to convey its half of the amount of flood-water by 927,999 cubic yards, but as the banks of the aqueduct were not quite completed when measured, we cannot say what sectional area they will contain when finished, but of this we feel certain, that by raising the lower bank a few feet, the discharge may be doubled so as to include the required amount.

But it may be objected that the great body of the flood-water will so spread over the land and flow past that the aqueduct cannot catch its proportion of it, this may be prevented by the construction of a low dam of an inexpensive character.

We hence affirm that the aqueduct, with slight additions to its lower bank, will be capable of conveying 31,831,648 cubic yards per annum into the reservoir, with a maximum delivery in time of floods, of 1,935,999 cubic yards in twenty-four hours, being half the assumed amount discharged by the Plenty after a rainfall of one inch within twenty-four hours.

Having thus determined the total amount that can be delivered into the reservoir from the River Plenty, our next subject of inquiry is relative to that derivable from the drainage basin of the reservoir, and also from the rainfall upon its surface, both of which can be arrived at from the data already determined on.

The area of the drainage basin of reservoir is 3,000 acres, or 14,520,000 square yards, obtained from Government surveys, a rainfall of 31 inches on which will equal 12,503,333 cubic yards; then the amount due to 17·856 inches loss from surface evaporation, as before determined, must be deducted, equal to 7,201,324 cubic yards, leaving 5,302,009 cubic yards derived from surface drainage into reservoir.

The area of the reservoir itself is 1,460 acres, equal to 7,066,400 square yards; hence 31 inches rainfall on the area would equal 6,084,955 cubic yards.

Hence the different amounts of supply to the reservoir will stand thus:—

Supply derivable from the River Plenty ...	31,831,648	cubic yards.
Supply derivable from drainage area of basin of reservoir	5,302,009	do.
Supply derivable from rainfall of 31 inches on surface of reservoir	6,084,955	do.
Total in reservoir	43,218,612	cubic yards.

This amount, as delivered into the reservoir, is subject to the further loss of evaporation from its surface, already determined at 9 feet of depth for still water, which, over a surface of 7,066,400 square yards, will give 21,199,200 cube yards to be deducted from the last amount, leaving 22,019,412 cube yards in reservoir.

This supply is equal to $101\frac{1}{2}$ gallons per head per day, for a population of 100,000 persons.

In thus laying before you, Mr. President and gentlemen, the results of our investigations, as also the several modes by which we have arrived at those results, we do so with much diffidence, being fully impressed with the difficulty in obtaining accurate results, under constantly varying conditions, resulting from meteorological changes, configuration and character of surface, &c. We believe that refined scientific deductions, relative to surface absorption and evaporation, however true under certain circumstances, are liable to many sources of error, where so many conflicting conditions have to be meted out, adjusted, and balanced with each other, so that each shall have a consideration consistent with scientific facts. We have not, therefore, attempted to solve this, the most important part of the problem, by such means, but viewing it more as a practical question due to this particular locality, we have, in the absence of local evidence, applied the data for surface evaporation of another country to this particular case; in the hope that its falsity or truth would be shown in the results it gave, when checked by legitimate deductions, we have shown how those results have been confirmed by the mean discharge on the eastern arm, and the other deduced therefrom. This result of mean discharge on the eastern arm was founded on accurate measurements, and most minute information as to summer and winter levels, furnished by a most intelligent farmer, in the immediate neighbourhood, who told us that the summer level was not lower than what we then saw it, and that the ordinary winter level was at the place of measurement up to the top of the banks, which exactly measured three feet above the summer level, and that the floods were over this again.

In calculating the mean discharge, we have made no allowance for increase of fall with the increase of volume, but, in ignorance of its amount, have taken it upon the known summer fall of 8 inches in two miles. We have also taken the discharge at such a point, near the head of the swamp, as to exclude at least six square miles of the drainage basin from the calculation. Taking all these circumstances into consideration, we believe our result of mean discharge is under the actual amount.

Our deduction of the mean discharge of the western arm from that of the eastern must appear obviously sound, when we consider that their conditions are precisely similar, their basins being both in the same formation, having the same soil and character, and therefore having the same per centage of loss from evaporation; their relative discharges must hence be as their superficial extent, diminished further by their ascertained loss in the swamps.

Our measurements of discharge have been obtained by finding the mean velocities, by the following formula, "double the square root of surface velocity in inches, deducted from surface velocity, and one added, gives the velocity at bottom, the mean velocity is half the sum of top and bottom velocities."

The calculations of loss from the swamps have been taken with such minuteness as circumstances would permit, that for the western swamp has been taken as if for still water, as the water spreads over the surface. The loss on the eastern swamps was truly represented by the excess of the discharge of the eastern arm above the swamps, over that of the Plenty below the swamps on the day of measurement, as at this time the Plenty was only fed by the eastern arm, the western being wholly lost in its swamps.

We have not attempted to disprove Dr. Wilkie's calculations, by carrying investigations in the same track, as we believe by doing so we could not arrive at a truthful result, inasmuch as he bases his calculations on the summer discharge, which is only derived from storage water in the ranges, which hold the water back and prevent it being delivered more suddenly, hence if there were no ranges there would be no summer discharge, although as much water would pass down. This is the case with the Merri Creek which has 122 square miles of basin, but as it does not rise in ranges, its waters near the source are not stored, but are delivered with rapidity according as they are received, there is therefore no summer discharge, hence measurements of summer flow, unless after rainfall, only indicate the least discharge.

It only remains therefore for us to state, it was impossible to follow up Dr. Wilkie's paper through the several allegations and deductions contained therein, inasmuch as his calculations are almost wholly based on the fallacy of summer discharge, which we have shown is only due to storage in the ranges, and which therefore only forms the dregs of the actual discharge.

The amount allowed by him for floods is assumed, and therefore cannot be depended upon, more especially as there is no defined line between least flow and highest floods, the discharges coming down in variable volumes between these points, hence the inaccuracy of computing ordinary discharges and floods separately, to obtain the total discharge.

We have therefore adopted a different mode of investigation to obtain those required results which we have now the honour of presenting to you, as representing such amounts of discharge and supply as are safely warranted by our calculations and deductions, while we are not prepared to state that they embrace the actual or total amount of same.

The following is a summary of the results of our calculations:—

Supply from Basin of River Plenty.

		Cube Yards.
Original supply by rainfall of 31 inches, on basin of 60 square miles		160,042,666
Loss from same—		
By absorption and evaporation over surface of basin, at the rate of 57 6 per cent. of rainfall ...	Cube Yards. 92,184,564	
By evaporation in swamps	4,194,804	
Making the total loss		96,379,369
Which loss deducted from the original supply by rainfall, gives the total discharge of the Plenty, per annum, above the reservoir, equal to		63,663,297
The half of this last amount being assumed as the greatest quantity that can be judiciously abstracted from the Plenty, will represent the total supply to the reservoir from the Plenty basin, equal to ...		31,831,648

Supply from Basin of Reservoir.

	Cube Yards.
Supply by rainfall of 31 inches, on basin of 3,000 acres, draining into reservoir	12,503,333
Loss on same—from absorption and evaporation over surface of basin, at the rate of 57·6 per cent. of rainfall	7,201,324
Which amount of loss, deducted from rainfall, represents the amount of drainage into reservoir from its basin, equal to	5,302,009

Supply from Rainfall on Reservoir.

	Cube Yards.
Rainfall of 31 inches, on 1,460 acres, superficial extent of reservoir, equal to	6,084,955

Total of various Supplies into Reservoir.

	Cube Yards.
Supply from basin of River Plenty	31,831,648
Do. do. reservoir	5,302,009
Do. rainfall on reservoir	6,084,955
Total of supplies in reservoir	43,218,612

Loss from evaporation over surface of water in reservoir, at the rate of nine feet deep, on asuperficial extent of 1,460 acres, equal to 21,199,200 cube yards.

Which amount of evaporation, deducted from the total of supplies in reservoir, will give the amount of water available for consumption, equal to 22,019,412 cube yards.

This total result is equivalent to $101\frac{1}{2}$ gallons per head per day, for a population of 100,000 persons.

Before concluding this report, we feel it our duty to represent the deterioration of the Plenty water, owing to the passage of its western and eastern arms through the swamps, we tasted the water above and below the swamps, in the former case it was perfectly clear and refreshing, and free from impurities, as coming from the rock, while below the swamps it had a flat unpleasent taste, and was not nearly so pure as that above the swamps; this deterioration of the water might have been avoided if the site of the reservoir had been chosen above the swamps, on the eastern arm, while the western arm might have been left to supply the settlers, the reservoir could be formed by the construction of a short dam, at the junction of Jack's Creek with the eastern arm, which would store nearly all the catch of the eastern arm above the swamps, equal to fifteen square miles, thus giving nearly 17,000,000 cubic yards, with a loss from evaporation on about half a square mile of reservoir surface, equal to 4,600,000 cubic yards, leaving 12,400,000 cubic yards, equal to fifty-seven gallons per head of pure delicious water, fresh from the rock, available for the supply of Melbourne, instead of 22,000,000 cubic yards of indifferent water, as in the present reservoir.

As it is now too late to adopt this scheme (and thereby avoid the loss by the evaporation of 21,000,000 cubic yards in the present reservoir), we are of opinion that the eastern and western arms of the Plenty should be diverted from the swamps through which they pass, by means of open cuts, carried round same, the water would thereby be conveyed into the reservoir as pure as from the ranges, and the loss from the swamps, or 4,194,805 cubic yards being hence avoided, would be added to the reservoir supply, making in all 26,214,217 cubic yards, equal to 121 gallons per head per day.

We have now had the honour of submitting our views on this important inquiry, and in conclusion beg to express a hope that the limited materials, in the form of data, local evidence, &c., from which we had to draw our conclusions and results, will be borne in mind, in forming an estimate of the mode in which we have treated this important subject.

We have the honor to be, Mr. President and Gentlemen, your very obedient humble servants,

F. C. Christy, C.E.
F. Acheson, C.E.

Art. XVI.—*On the Influence of the Physical Character of a Country on the Climate; being a Letter to the President, by* R. Brough Smyth, Esq., *Mining Engineer.*

Museum of Natural History, Melbourne.
March 8, 1855.

Sir,

Considerable attention being directed, at this time, to the capabilities of the rivers in the colony of Victoria, in respect of water supply, I have the honour to submit, for your perusal, the following observations:—

I am aware that attempts have been made, very recently, to calculate the probable annual discharge of water from a river by computing the drainage area, the rainfall, the evaporation, &c., but as there are other counteragents, equally worthy of attention, and bearing directly upon the results of such calculations, I propose to offer some remarks, that may, perhaps, arrest the attention of those immediately interested.

My present object is more particularly to inquire how far the physical character, and the geological structure of a country, extend their influence over peculiarities of climate and in what manner they serve to determine the hydrographical features. This connexion, Sir, which I shall seek to establish and enlarge, is, as you are aware, not new to those who have made the science of Geology their study. As I design to apply it, in a practical sense, to the solution of some questions which have been lately brought before the Philosophical Society, I feel that I shall best accomplish this purpose, by divesting it entirely of purely local interest. This increases the difficulties of the subject, which I approach with some reluctance, aware of the many and great sources of error to which all such inquiries are liable; and